Overview of ecosystem-based modeling and analyses – IEA in Alaska

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The NOAA IEA Process

Define Ecosystem Management Goals & Targets

The IEA process involves manager engagement to identify critical ecosystem management goals and targets to be addressed through and informed by the IEA approach. The rest of the process is driven by these defined objectives. Engagement is continual throughout the entire IEA process.

Define EBM Goals & Targets

Management Strategy Evaluation

MSE is useful to help resource managers consider the system trade-offs and potential for success in reaching a target which helps make informed decisions. It uses simulation through ecosystem modeling to evaluate the potential of different management strategies to influence the status of natural and human system indicators and to achieve our stated ecosystem objectives.

Evaluate Strategies

Implement Management Action

Refine Goals and Targets or Indicators

Monitoring of Ecosystem Indicators

Develop Indicators

Develop Ecosystem Indicators

Indicators represent key components in an ecosystem and allow change to be measured. They provide the basis to assess the status and trends in the condition of the ecosystem or of an element within the system. Indicators are essential for all subsequent steps in the IEA approach.

Assess Ecosystem

During this step, individual indicators are considered together to further evaluate the overall current status or condition of the ecosystem relative to threats and risks, historical state, and to ecosystem management goals and targets.

Assess Ecosystem

Analyze Status, Trends & Risk

Analyze Status, Trends & Risk

Ecosystem models are used to evaluate the status, trends, and risk to the indicators posed by human activities and natural processes. This step is important in determining incremental improvements or declines in ecosystem indicators in response to changes in drivers and pressures and to predict the potential that an indicator will reach or remain in an undesirable state.

Taking, Monitoring, and Refining Action
Based on the MSE, an action is selected and implemented (on occasion the goal and/or target may need to be refined rather than take an action). Monitoring of indicators is important to determine if the action is successful; if yes, the status, trends, and risk to the indicators continue to be analyzed for incremental change; if not, either goals and targets or indicators need to be refined as part of adaptive management.

For more information visit: www.noaa.gov/iea

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IEA work is PLACE-BASED

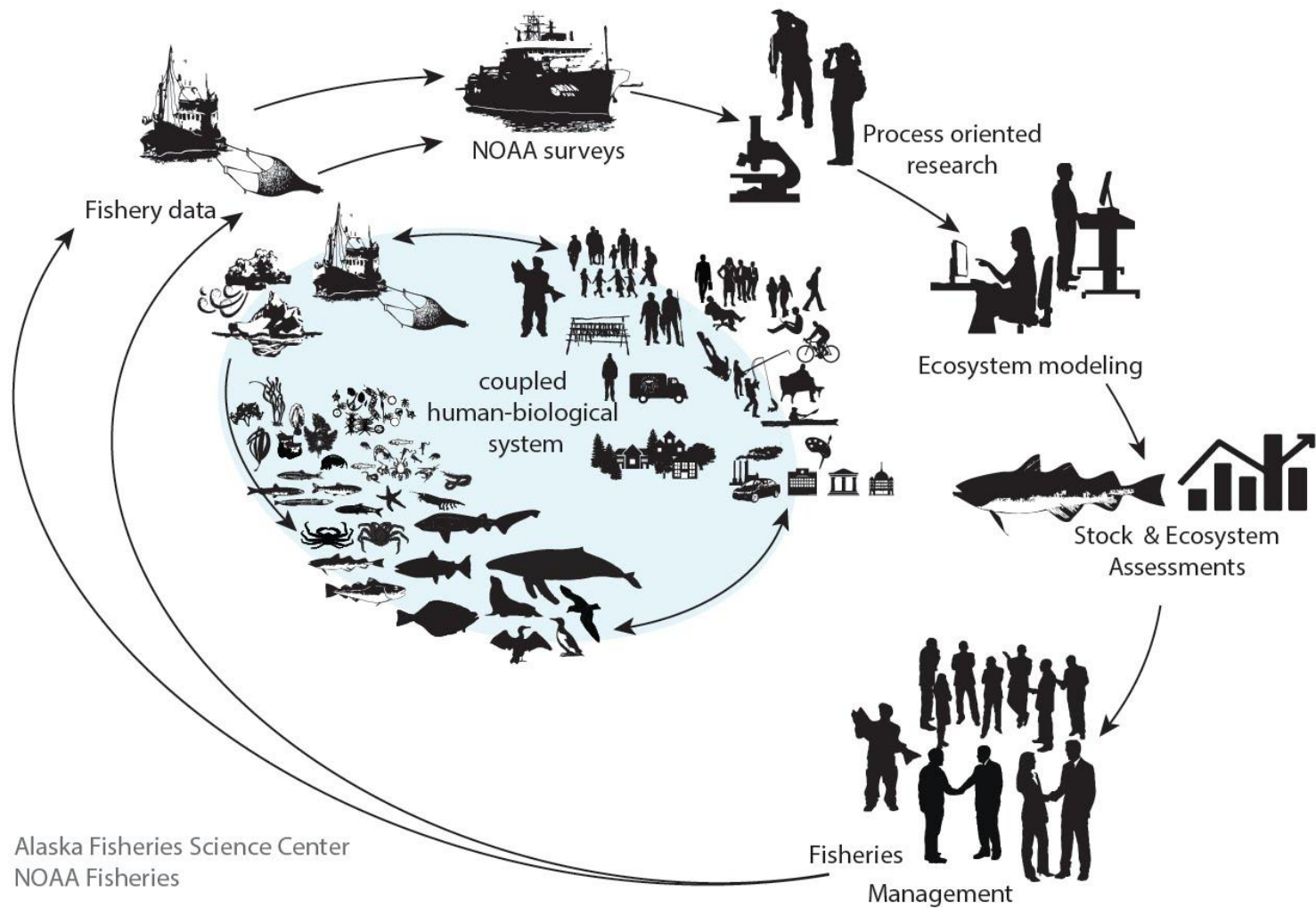|	Arctic	EBS	AI	GOA
Fishing	×	🟢	🔵	🔵
Population	🔵	🔵	🔵	🟢
Oil/Mineral	🟢	🔵	🔵	🔵
Climate change	🟢	🟢	🔵	🔵
Tourism	×	🔵	🔵	🟢
Shipping	🔵	🔵	🟢	🟢
Aquaculture	×	×	×	🔵
Forestry	×	×	×	🟢

Four *separate* IEA processes/teams

Advantages
• Tailored to stakeholders
• Synoptic
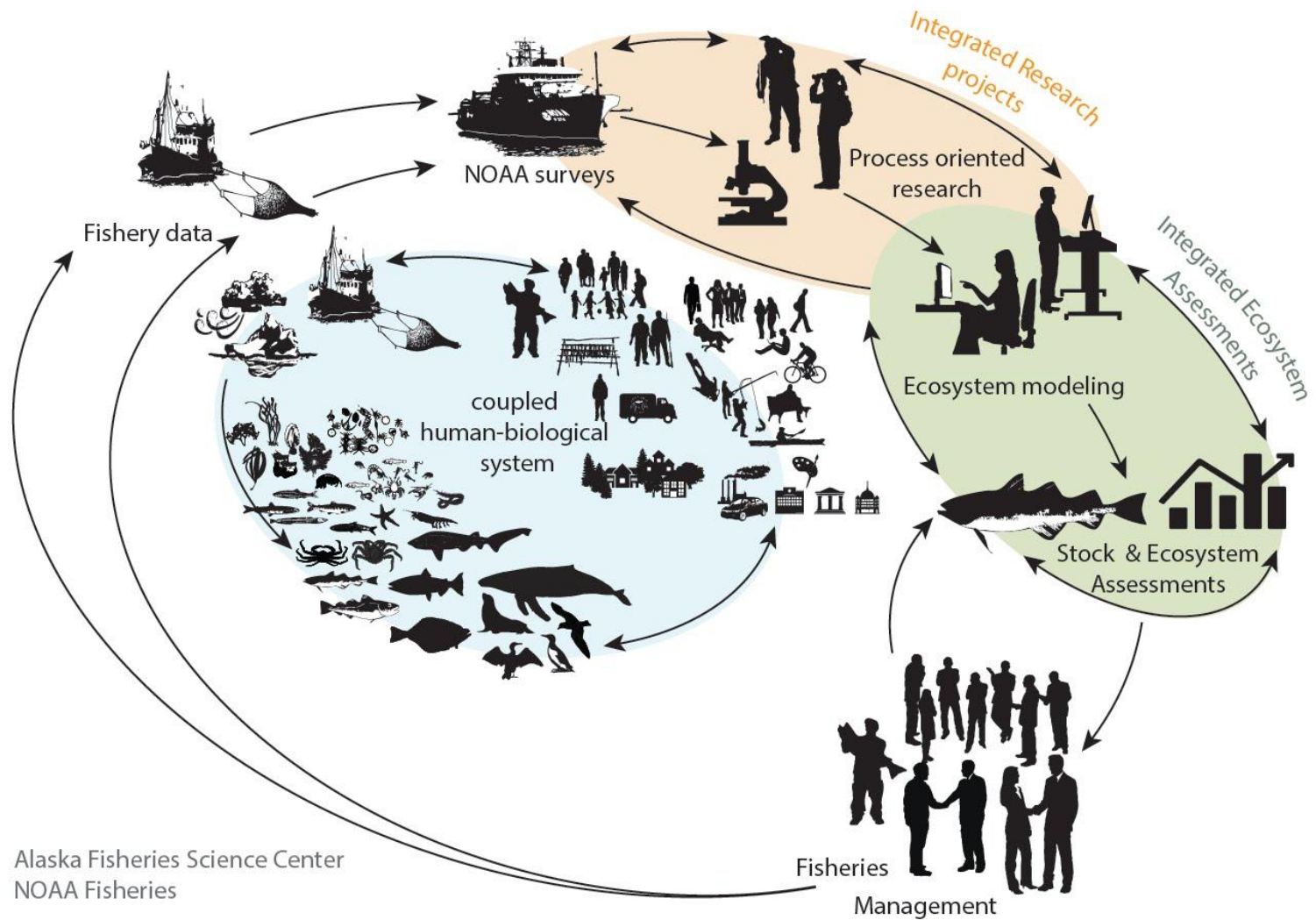• Model/field integration (IERPs)

Disadvantages
• "Poorer" LMEs get less attention.
• Skilled staff is "same".

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Fishery data

NOAA surveys

Process oriented research

coupled human-biological system

Ecosystem modeling

Stock & Ecosystem Assessments

Fisheries Management

Alaska Fisheries Science Center
NOAA Fisheries

Fishery data

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Integrated Research projects

Process oriented research

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Alaska Fisheries Science Center
NOAA Fisheries

Fisheries

Management

Bering Sea IEA – "It's the climate, stupid"

- **Four IEA regions (Bering Sea, Gulf of Alaska, Aleutian Islands, High Arctic)**
- **Bering Sea "maturing", Gulf of Alaska "scoping", others "pending"**

	Bering ROMS/NPZ modeling, PMEL/AFSC partnership	Bering multispecies/ ecosystem models	Econ/ social	Bering FEP	GOA IEA
FY13	Development				
FY14	Operational council product: 9-month forecasts of Bering physics, biological indicators	CEATTLE model (multispecies assessment model)			
FY15	Climate-driven MSEs (driven by 50-year IPCC forecasts)	CEATTLE MSEs + Ecosim toolbox	FishSET toolbox		
FY16	Rapid climate assessment Yukon Chinook salmon survival 9-month forecast testing	Ecosim toolbox Support model updates - several models for multi-model MSEs (ACLIM)		Council priority: Conceptual models, analysis support	Conceptual models, GOA IEA planning and scoping
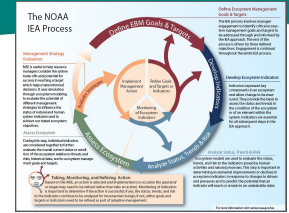
Products - and route to Council

- **Fisheries Ecosystem Plans** - Ecosystem Plan Teams?

- **Ecosystem Indicators**

- **Ecosystem Assessment** — Ecosystem Considerations

- **Ecosystem Models**

- **Risk Assessments** - Stock Assessments, FEP

- **Management Strategy Evaluations** - FEP, Stock Assessments, Ecosystem Considerations

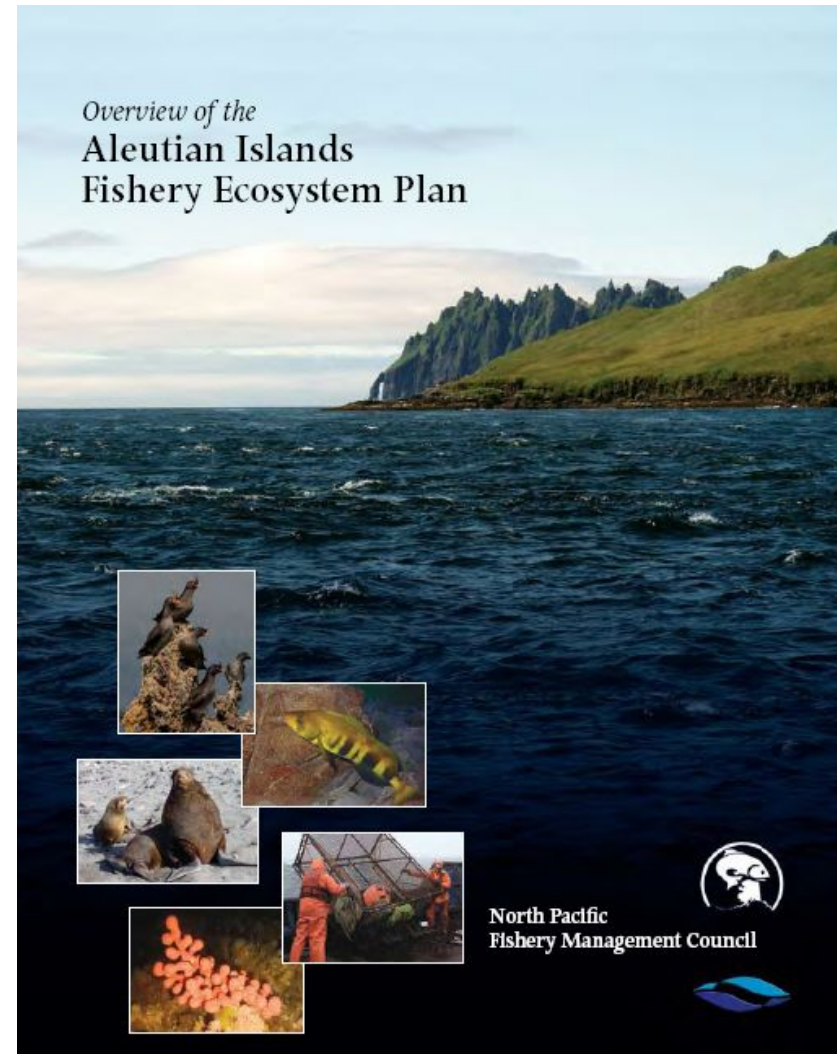# The North Pacific Fisheries Management Council annual process

Aug, Sept } Stock assessments → Ecosystem considerations ← Ecosystem Indicators, syntheses

Stock assessments, Ecosystem considerations → Regional Plan Teams

Sept, Nov } Regional Plan Teams

Regional Plan Teams → Scientific and Statistical Committee, Advisory Panel

Dec } Scientific and Statistical Committee, Advisory Panel → Council

Ecosystem information addressed at each level

Council → **Fishery quotas set**

Fisheries Ecosystem Plans

Initial plans "general scoping and framing", not living documents.

Upcoming: Bering Sea FEP, a "living" document or plan.

Overview of the
Aleutian Islands
Fishery Ecosystem Plan

North Pacific
Fishery Management Council

NOAA
FISHERIES
SERVICE

Fisheries Action Plan Process
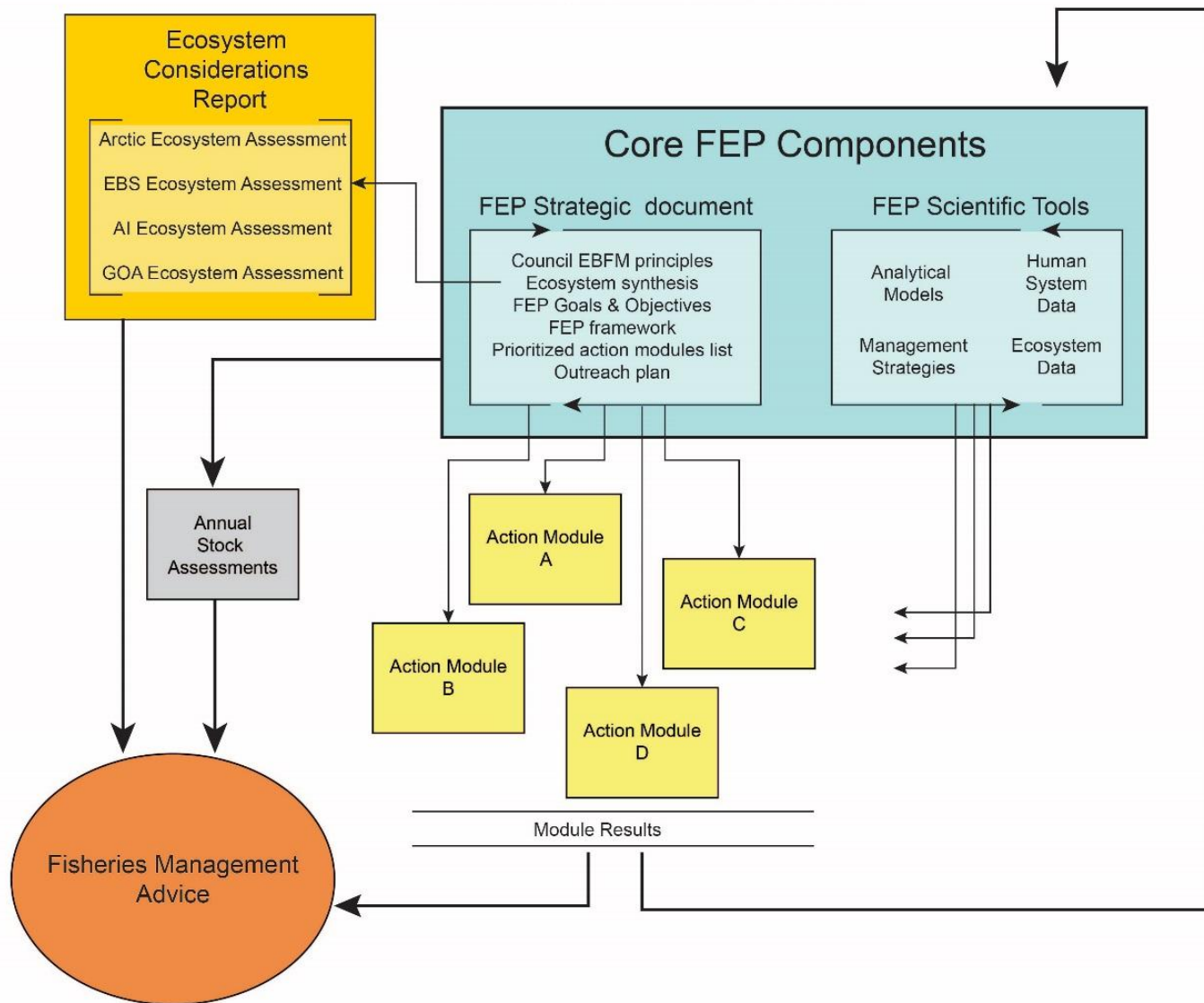
Ecosystem Indicators and assessment

Models by region

	EBS	GOA	AI	ARCTIC
ROMS/NPZ	*	O	?	?
Enhanced assessment	*	*	*	
Food web	+	+	+	+
Multispecies statistical	*		O	
Size Spectrum	O			
IBM		O	?	
FEAST-type	*		?	

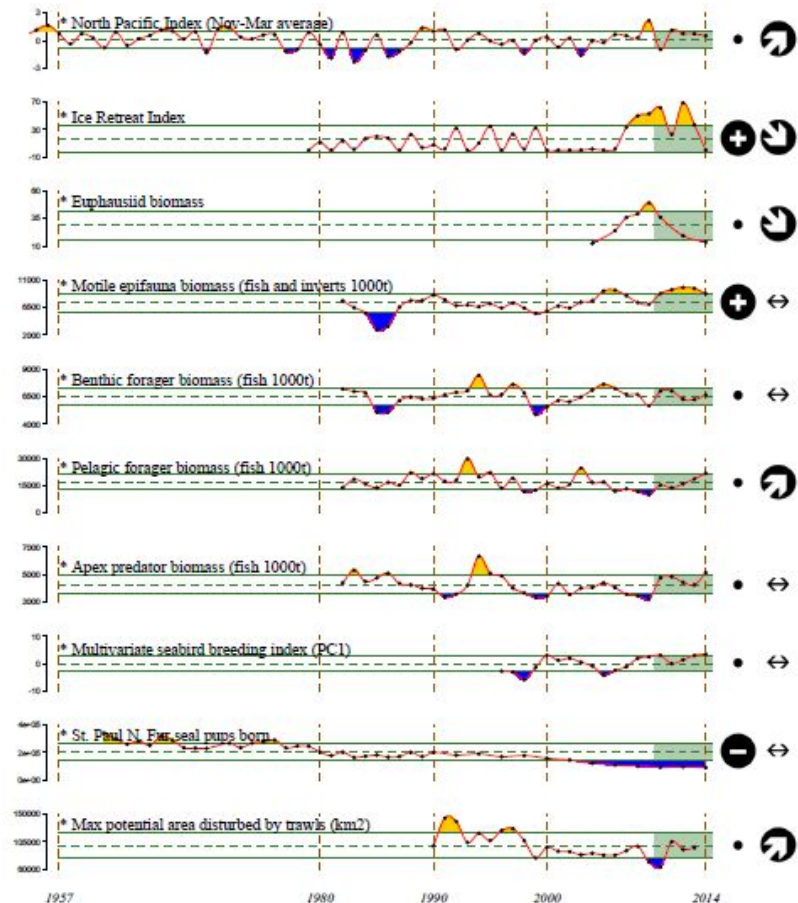* Annual or biennial part of assessment, requested or required by Council.
+ Up-to-date for providing issue-specific advice.
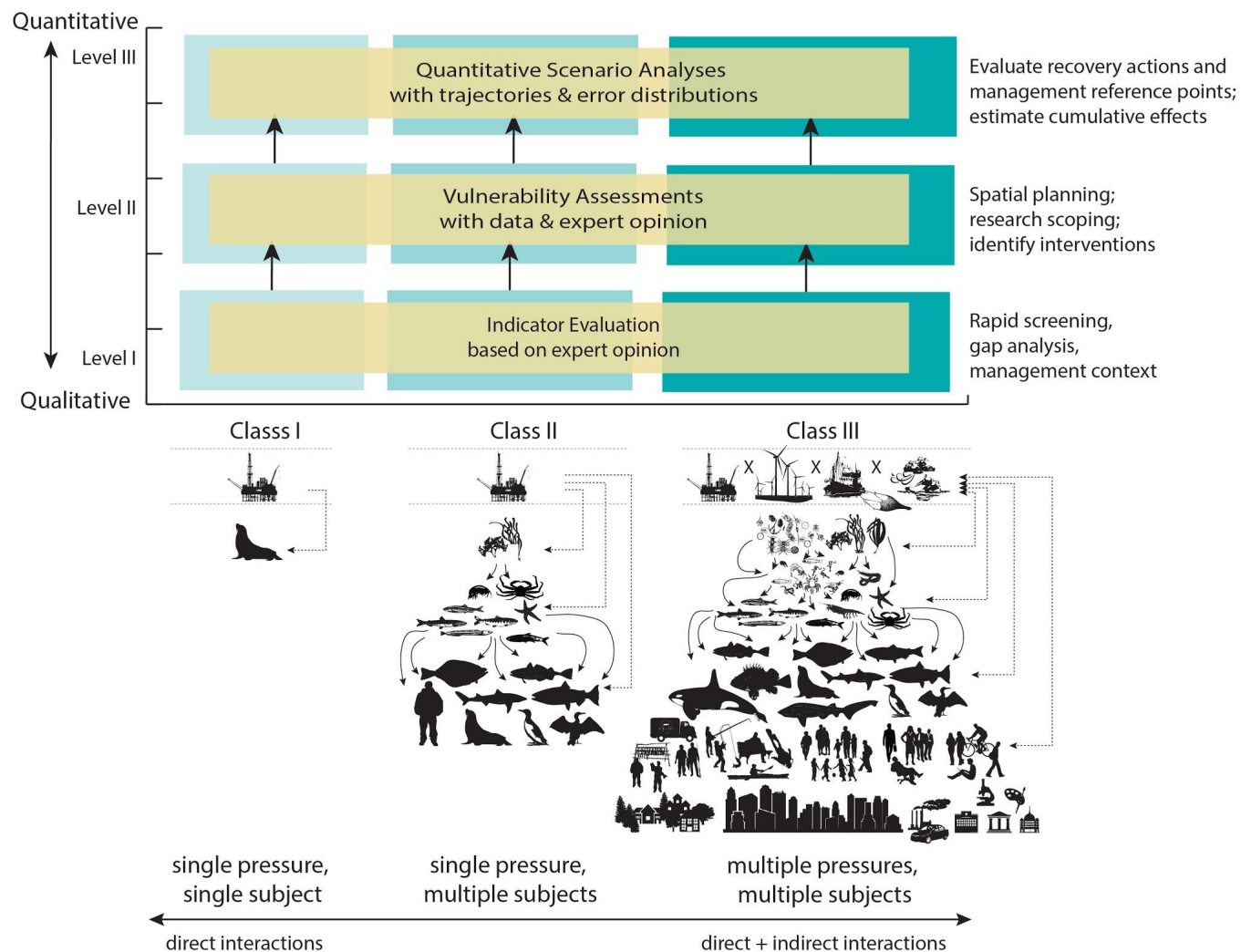O Under active development.
? Proposed.

Eastern Bering Sea 2014 Report Card

- The North Pacific atmosphere-ocean system during 2013-2014 featured the development of strongly positive SST anomalies south of Alaska. This warming was caused by unusually quiet weather conditions during the winter of 2013-14 in association with a weak Aleutian low (positive NPI), and abnormally high SLP off the coast of the Pacific Northwest.

- The eastern Bering Sea experienced warmer air temperatures and less sea ice that were related to the broader North Pacific conditions. Dates of sea ice retreat, summer surface and bottom temperatures, and the extent of the cold pool were similar to those of the warm years of 2003-2005.

- The summer acoustically-determined time series of euphausiids continues to decrease from its peak in 2009. This suggests that prey availability for planktivorous fish, seabirds, and mammals was low in 2014.

- Survey biomass of motile epifauna has been above its long-term mean since 2010, although the trend has stabilized. However, the trend of the last 30 years shows a decrease in crustaceans (especially commercial crabs) and a long-term increase in echinoderms, including brittle stars, sea stars, and sea urchins. It is not know the extent to which this reflects changes in survey methodology rather than actual trends.

- Survey biomass of benthic foragers has remained stable since 1982, with interannual variability driven by short-term fluctuations in yellowfin and rock sole abundance.

- Survey biomass of pelagic foragers has increased steadily since 2009 and is currently above its 30-year mean. While this is primarily driven by the increase in walleye pollock from its historical low in the survey in 2009, it is also a result of increases in capelin from 2009-2013, perhaps due to cold conditions prevalent in recent years.

- Fish apex predator survey biomass is currently above its 30-year mean, although the increasing trend seen in recent years has leveled off. The increase since 2009 back towards the mean is driven primarily by the increase in Pacific cod from low levels in the early 2000s. Arrowtooth flounder, while still above its long-term mean, has declined nearly 50% in the survey from early 2000s highs, although this may be due to a distributional shift in response to colder water over the last few years, rather than a population decline.

- The multivariate seabird breeding index is above the long term mean, indicating that seabirds bred earlier and more successfully in 2014. This suggests that foraging conditions were favorable for piscivorous seabirds.

- Northern fur seal pup production for St. Paul Island remained low in 2014, with fewer pups produced than the last survey in 2012.

Chart panels (top to bottom):
* North Pacific Index (Nov-Mar average)
* Ice Retreat Index
* Euphausiid biomass
* Motile epifauna biomass (fish and inverts 1000t)
* Benthic forager biomass (fish 1000t)
* Pelagic forager biomass (fish 1000t)
* Apex predator biomass (fish 1000t)
* Multivariate seabird breeding index (PC1)
* St. Paul N. Fur seal pups born
* Max potential area disturbed by trawls (km2)

1957   1980   1990   2000   2014

Includes *annual synthesis* of trends

Ecosystem Risk Assessment Framework

Holsman, Samhouri, Cook et al. *in prep*

Risk Assessment
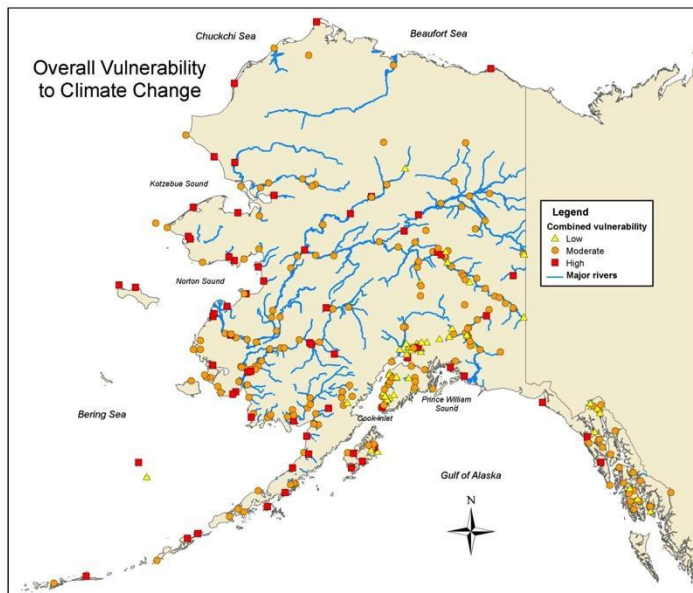
Himes-Cornell and Kaspersky 2014
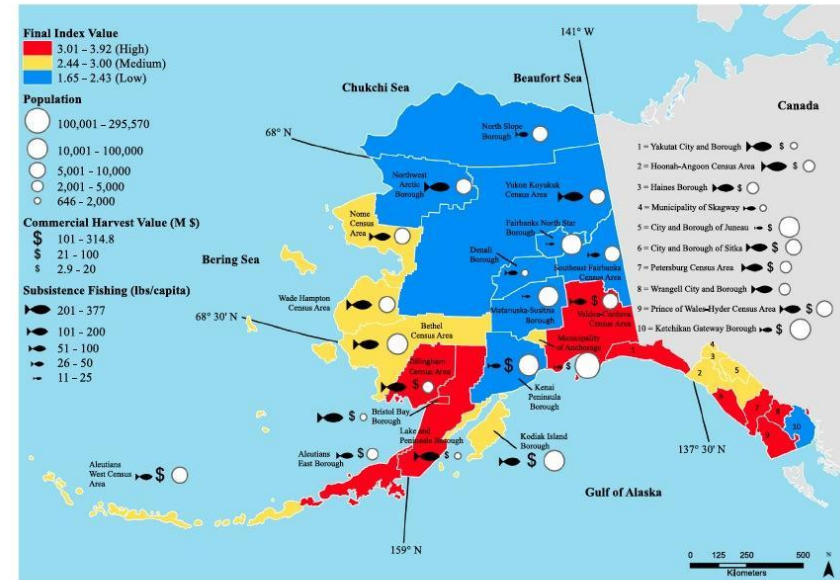
Fig. 11. Individual components of the final ocean acidification risk index for each census area.
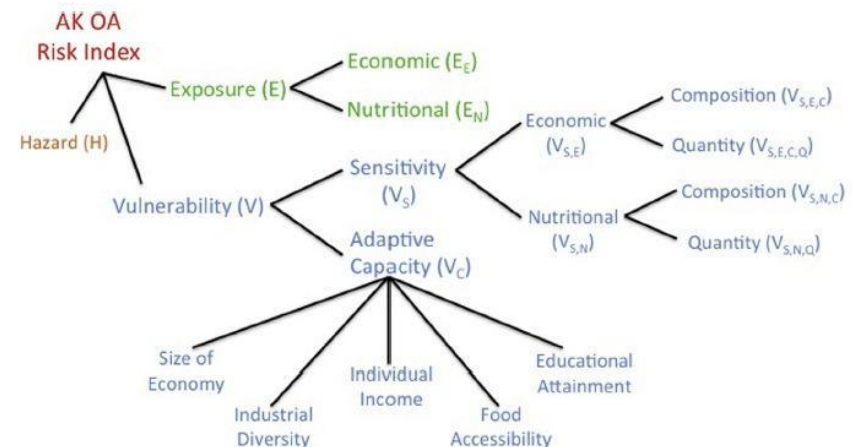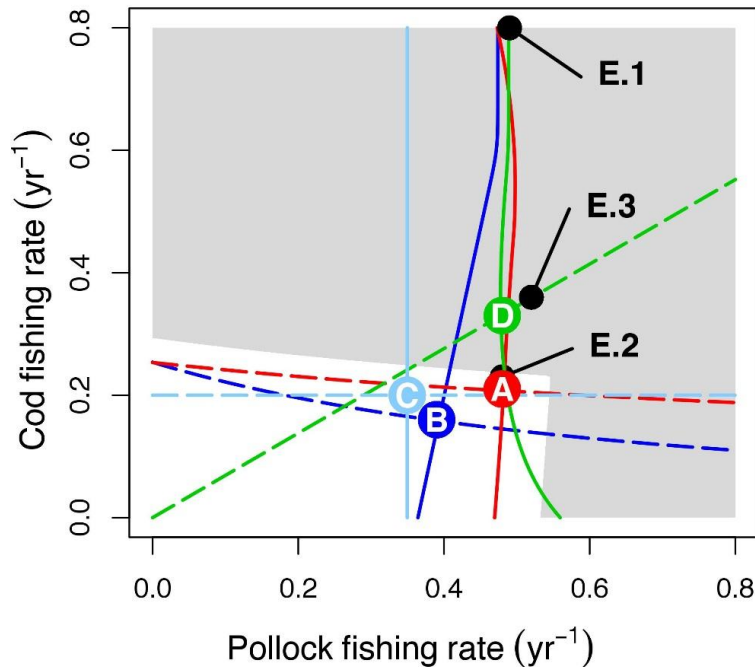

Fig. 3. Components of the risk index. Each branch is evenly weighted relative to others at the same level.

Management Strategy Evaluations

- ACLIM - IPCC climate impacts on Bering Sea
- Impacts of altering age sampling on quality of stock assessments
- Salmon bycatch alternatives on EBS pollock
- Altering halibut bycatch caps
- Stock assessment prioritization – impacts on ACLs
- EFH mitigation alternatives
- Spatially-explicit sablefish assessment
- Alternatives for opening the southern part of the northern Bering Sea for selected fishing
- Ocean acidification effects on snow and Tanner crab
- Changing currency for management of Alaska Crab stocks

Moffitt et al. 2015, included Council/stakeholder workshops on management alternatives

Inclusion into management advice (TOR 6)

- Alaska scope is EAF/EBFM, not EBM

- Primary audience is Fisheries Management Council
  - Secondary is outreach to stakeholders/communities

- Primary species focus is: groundfish, crabs, salmon
  - Secondary: endangered species and fisheries interactions (Stellar Sea Lions, Short-tailed Albatross)

- Strong Council buy-in (longstanding ecosystem committee, measures taken)

- Gap analysis (or "Conceptual Model" development) part of Bering FEP

- Strong direct link through stock assessment process (ecosystem researchers contribute directly, work alongside, sit on Plan Teams).

- Role of "synthesis analyst" in ecosystem assessment is greater than the sum of the time series.

Peer-review (TOR 7)

- Plan Teams request ecosystem-related advice, make specific recommendations.

- Strongest peer-review is through SSC – ecosystem chapter sees thorough review annually.

- Some "assessment-advice" models to be included as alternative models for stock assessment review.

- Ecosystem-level advice (e.g. scientific methods for setting OYs) awaits further scientific developments.

Communication (TOR 8)

- Annual presentations to Council made **in the direct context/ immediately before groundfish quotas**, led to reductions.

- Website for ecosystem indicators

- Council ecosystem committee with regular meetings

- Stakeholder involvement in goal-setting (e.g. in determining alternatives for management strategy analyses)

- Bering FEP has specific outreach components